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NECK MOVEMENT BASED WHEELCHAIR TO ASSIST THE PHYSICALLY CHALLENGED

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ABSTRACT

The challenging problem faced by quadriplegics and paralyzed people is their need for independent mobility. They need external help to perform their daily activities. The main objective of this project is to provide an automated system for disabled people to control the motor rotation of wheelchair based on neck movement of physically challenged person. To facilitate these people for their independent movement, tilt sensor is fitted on person neck. Based on the neck movements, the accelerometer (tilt sensor) will drive the motor fitted to the wheelchair. The wheel chair can be driven in any of the four directions and it can also be controlled by using android app (Blynk app). The automated wheelchair is based on simple electronic control system and the mechanical arrangement that is controlled by a Controller. *The ultrasonic sensors help to avoid obstacles, using the environment information gathered during navigation. The temperature sensor and heartbeat sensor constantly measure the parameters and display it on LCD.*

Keywords- *Temperature sensor, Heartbeat sensor, Ultrasonic sensor, LCD, Blynk app, Accelerometer*

1. INTRODUCTION

"World report on disability" jointly presented by the World Health Organization (WHO) and World Bank says that there are 70 million handicapped people in the world. Unfortunately day by day the number of handicapped people is increasing due to road accidents as well as disease like paralysis.

There is a continuous need of wheelchair to help people, who need to move around, with the help of some artificial means, whether due to an illness or an accident. This means we have to take advantage of technological evolution, in order to increase the quality of life for these people and to facilitate their integration into the working world.

The conventional Joystick wheelchair requires hand movement for controlling the wheelchair, which is not suitable for physically handicapped people. This can be overcome by Electric wheelchairs or Head motion controlled wheelchair, but Electric wheelchairs costs around 50,000 and more which is not affordable by the common man. The Neck motion controlled wheelchair is suitable for those whose hands or fingers are paralyzed.

The objective of this project is to design a tilt sensor based wheelchair that can be operated with the help of both neck movement and android app. The wheelchair is fitted with an Ultrasonic sensor, Temperature sensor, Heartbeat sensor, Motor, LCD and is connected with an android app to help driver to achieve some independent mobility.

An accelerometer is used to sense motion. Control equipment fitted to patients head is used to control wheelchair. The two geared DC motors are used for the motion of prototype model. If the patient wants to move in a particular direction, the patient can tilt the accelerometer in that direction. Here the current is too low to drive DC motors, hence we use L293D driver.

By using an android app, the wheelchair can be moved in 4 directions. The Ultrasonic sensor can help the rider control the wheelchair by taking over some of the responsibility for steering and avoiding objects until the user is able to handle the job. The Temperature and the Heartbeat sensors constantly measure the parameters which are also displayed on the LCD and message is sent through GSM to the nearby hospitals or the patient's relatives in case of emergency.

This wheelchair is designed at a lower cost as compared to the other versions available in the market.

2. OBJECTIVES

The following are the objectives of this paper:

The main objectives of this project are:

- To help the quadriplegic patients to move independently from one place to another with the help of wheelchair by movement of their neck using tilt sensor and blynk app.
- Implementation of ultrasonic sensor to avoid obstacles like edges or staircases in path of the wheelchair.
- To measure the heartbeat and temperature of the patient and display it on LCD.
- To alert the families in time of emergencies like increased heartbeat and temperature using GSM.
- To simulate the wheelchair circuit using Proteus software.

2.1 PROBLEM FORMULATION

2.1.1 Problem statement and solution

1. To control the movement of wheelchair

The wheelchair can be controlled in two ways.

i. The wheelchair can be moved in all the four direction using tilt sensor. The tilt sensor recognizes the direction of neck movement and moves accordingly.

ii. The wheelchair can also be moved using blynk app. The user can move the wheelchair by pressing the respective button in the app.

2. To determine the obstacle on the path and avoid the obstacle

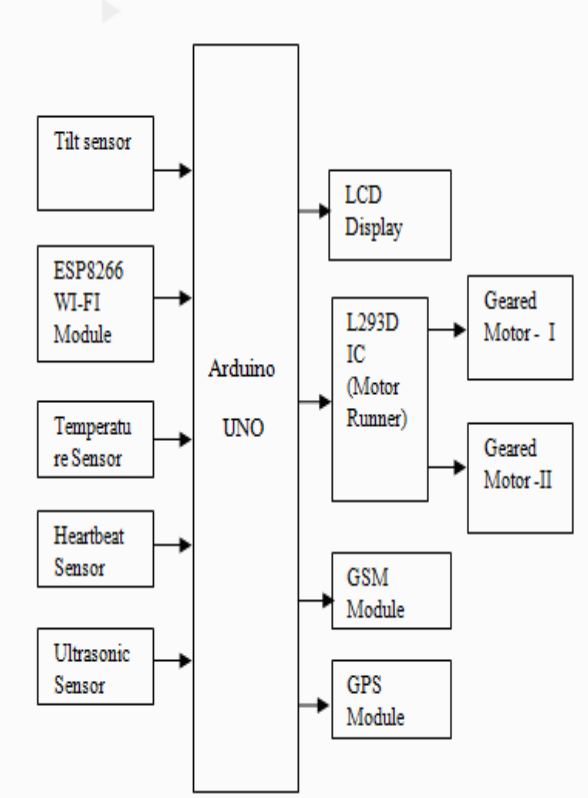
The above problem can overcome by using ultrasonic sensor. The ultrasonic sensor is mainly used to detect larger obstacles, which are well visible by the persons anyway. By using ultrasonic sensor obstacles like edges or staircases in the path of the wheelchair can be avoided.

3. To monitor the patient's condition and intimate to concerned person

Patient is constantly monitored by using heartbeat sensor and temperature sensor. If the heart beat or temperature exceeds the given threshold, message is sent through GSM to the concerned people.

3. METHODOLOGY

3.1 Block diagram of neck movement-based wheelchair



The proposed system consists of Arduino Uno, heartbeat sensor, temperature sensor, ultrasonic sensor, GPS, GSM, LCD display, Motor driver(L293DIC),DC motors,accelerometESP8266 module.

Accelerometer consists of x and y axis, where x is connected to A0 and y is connected to A1 port of the arduino board. L293DIC consists of IN1, IN2, IN3, IN4, OUT1, OUT2, OUT3, and OUT4. Where IN1,IN2,IN3,IN4 pins connected to A3,A4,A5,A6 Port of the arduino board and OUT1,OUT2 is connected to motor 1(M1) and OUT3,OUT4is connected tmotor2(M2).Ultrasonic sensor consists of trig pin and echo pin. Echo pin is connected to 9 pin of the arduino board and trig pin is connected to the 10 pin of arduino board. Heartbeat sensor is connected to the 3 pin of the arduino and Temperature sensor is connected to the A2 port.

ESP8266 Wi-Fi module consists of Rx and Tx where Rx is connected to the TX1 of the arduino and Tx is connected to the Rx pin of the arduino board.LCD consists of RS,RW,EN,D4,D5,D6,D7, where RS,RW,EN is connected to the pin number 12,GND,11respectively.D4,D5,D6,D7is connected to the pin number 7,6,5,4 respectively.GSM consists of Rx and Tx ,where Rx is connected to the Tx and Tx is connected to the Rx pin of the arduino.

4. SOFTWARE DESIGN AND RESULTS

The main software used for implementation in this paper is Arduino IDE, Proteus software and blynk app. The programming language used to write a code for Arduino is embedded C. Android studio is the tool used to develop the android application. Here the proteus software is used for circuit designing and to get the simulation output. Blynk app is used to control or monitor the wheelchair across all 4 directions (left, right, front, back, and stop).

5. PROCESS STAGES

1. Tri-Axis Accelerometer is an integrated module that can sense gravitational force of +or – 3g on three axes (x, y, z). A four channel 12-bit ADC is used to convert the Analog voltage from the accelerometer to digital outputs. This is also used to read the voltage outputs of the sensor.

2. The accelerometer (Tilt sensor) was used to detect a slight tilt of the neck.

3. The Tilt sensor or Accelerometer placed on the patient's' neck measured the tilt Produced by the neck movement. The patient was made to tilt his/her head in right, left, front or backward direction. The tilt corresponds to the Analog voltage (values).

4. ADC is used to convert the analog signal into digital values in which digital Correspond to the amplitude.

5. As soon as we switch on the power supply, the accelerometer will show some value then the value is been noted and stored in the arduino board usually the accelerometer will be in the range of 300 to 400. For each direction it will have some threshold values.

6. The obtained digital signal (value) is sent to the motor driving IC (L293D). The source code for arduino has been written in the embedded c language. Based on the source code the Arduino drives the motor Driver section (L239D) helps to drive the DC motors simultaneously.

7.The input voltage is 12v 2 Amps and converting into 5V 2Amps using 7805 Voltage regulator Step-down transformer has been used to step-down the voltage from (230V) to Required Voltage (12V battery).A bridge rectifier has been used to convert an alternating current input into a direct current output(2Amps)

8.Filter circuit has been used for eliminate the undesired high frequencies (noise) that are present on ac input lines.7805 voltage regulator has been used to maintain the fluctuations, is a popular voltage regulator integrated circuit(IC). And to control the voltage in the prescribed range that can be tolerated by the electrical equipment using that voltage.

9. Patient is monitored by using the Heartbeat sensor and Temperature sensor. If any, Abnormality found in the health condition, if heartbeat or Temperature is low or high, it will be displayed on the LCD.

10. If heartbeat (more than 72bpm) and temperature (more than 37 degree Celsius or 99.5 F) is varied message is sent using GSM, also upon any abnormal condition message is sent via GSM module with text "Emergency".

11. If any obstacle is found (with in 10 cm), the wheelchair should stop by the help of ultrasonic sensor GPS (Google maps) module is used to determine the location of the patient.

6. LITERATURE SURVEY

Authors	Papers	Methodology	Advantages	Disadvantages
1.Rajesh Kannan Megalingam, Sarath Sreekanth, Govardhan A, Chinta Ravi Teja, Akhil Raj	Wireless Gesture Controlled Wheelchair	The objective of this research work is to develop a wireless control system using hand gestures with the help of electronic gadgetslikesmartphones or tablet using Android application. The interface is made user-friendly by using the Android platform as it provides various open tools for this task.	It has the advantage that it uses the immensely popular android platform and the system can be controlled by palm movements rather than fingers	Its major disadvantage lies in the fact that it cannot be used by paralyzed patients or people who have lost their arms.
2.LiviuFlorin Manta, Andrei Dragomir, Dorian Cojocaru, Alexandru Marin Mariniue, Ionel Cristinel Vladu	Wheelchair controlled by head motion using a non contact method in relation to the patient	The paper describes the current progress of the research work in designing of an intelligent human machine interface based on head movement tracking as command input source.	The devices are integrated and a control system is designed with a user friendly interface, dedicated for persons with severe disability, and shared obstacle avoidance functionality which assist the wheelchair user along his traveling path.	It's disadvantage lies in its cost, reliability and efficiency
3.Shraddha Uddhav khadilkar, Narendra Wagdarikar	Android phone controlled Voice, Gesture and Touch screen operated Smart Wheelchair	In this paper, a wheelchair is proposed in which, by just tilting smart phone which is with the wheelchair user, the wheelchair can be moved in 4 directions. The approach allows the user to use human voice, gesture movement Smartphone	By using this system physically handicapped people find it easy to move around within the house using wheelchair without the external help. This provides ease of operation. The system uses Smart phone so that the accuracy is increased	The limitations of this system are that it doesn't help quadriplegics and blind people.
4.Trinayan Saharia, Jyotika Bauri, Mrs. Chayanika Bhagabati	Joystick Controlled wheelchair	In this paper a joystick controlled wheelchair is proposed which is designed using robotics and intelligent system technologies. A microcontroller is employed to monitor and control the system	A wheelchair is designed for the physically disabled people who cannot walk, so that they can easily handle it with their hands by using the Joystick	This project does not reach out to those people who cannot move their legs as well as hands.

6.1 ADVANTAGES ANDAPPLICATION

6.1.1 Advantages

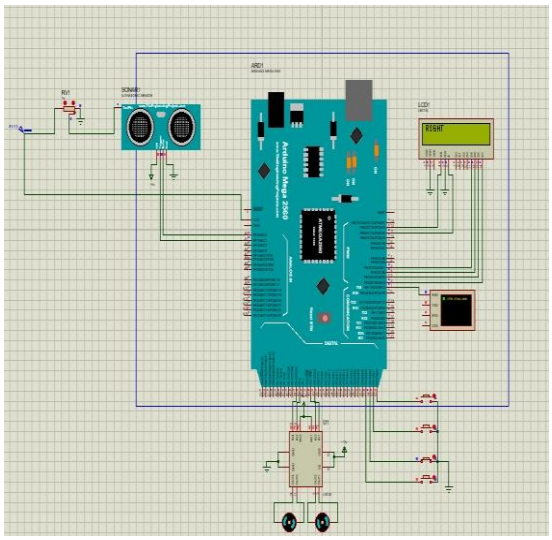
- It is user friendly
- It can be operated both by the android app and neck movement.
- Without any external help the paralyzed person can operate his own wheel chair.
  Sensors are easily available and less cost.
- The person can move the wheel chair easily in the Left, Right, Forward, and Backward directions or stay in the same position.
- It provides independence, freedom, mobility, easy to use.

6.1.2 Applications

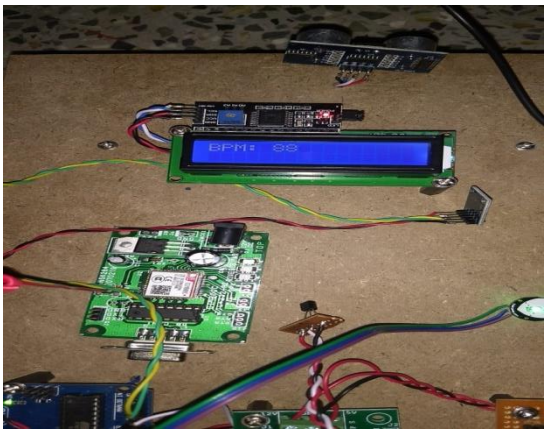
- This system can be used by physically handicapped people who is impaired in all 4 limbs, permanently wheelchair bound, whose function does not enable him to manually move a wheelchair over reasonable functional distances.
- Any disabled person with a mobility, pain-based impairment or cardio-vascular issues may find these chairs advantageous in some circumstances.
- To help old people whose age exceeds 70 and who are unable to move from one place to another without the support of another person.
- It can also be used during military emergencies to assist the warriors whose body parts are wounded without them having to depend on others.
- **7. RESULTS AND DISCUSSION**

7.1 Results

All the programming is done by the Arduino IDE and the program is loaded into the Arduino board. The tilt sensor gives a facilitated control over the wheelchair. After interfacing of all components according to the circuit diagram we get the desired output. In this project tilt sensor, an Arduino ATMega328P Controller, L293D IC, two DC motors, heartbeat, ultrasonic and temperature sensors, LCD and 12v battery are used. The functional operations are implemented using the microcontroller. The functions are developed in such a way that they able to provide more accurate sensitivity and response in moving and direction change. The response time of the functions with respect to the sensors is tested for several times and designed and modified the program in order to achieve good results. The tilting of the neck in the back and front directions are used to control the direction of the vehicle both in forward and backward direction. Similarly, the tilting of the neck in the left and right directions are used to the control the direction of the vehicle in right and left direction. The functions reads the input signals from various sensors through analog inputs and sends output to output devices like motors to control the wheels rotation. The wheelchair detects the obstacle at the front and stops its movement. Temperature and heartbeat is constantly measured and is displayed on the LCD and also message is sent through GSM during an emergency and the patient's location is tracked using GPS. The movement of the wheelchair can be also controlled by using the Blynk app in addition to the neck movement.

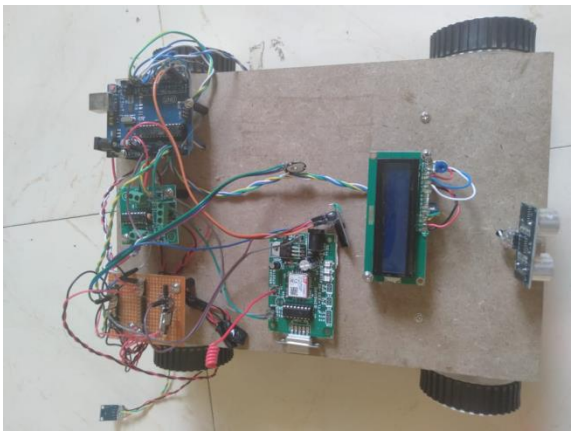


Simulation output (Right is displayed on the lcd) using proteus software.



Outcome of Hardware implementation (Heart rate is displayed on LCD)

Outcome of Android application (Blynk app).
Display of wheelchair movement in the backward, forward, right and left directions using blynk app.



Prototype of the neck movement based wheelchair

8. CONCLUSION AND FUTURE SCOPE

8.1Conclusion

The project mainly focuses on 4 objectives. The first objective is to help the quadriplegic patients to move independently. The second objective is to avoid the obstacles like edges or staircases in path of the wheelchair. The third focuses on measuring the heartbeat and temperature of the patient and displaying it on LCD. And the last objective focuses on alerting the families in time of emergencies.

- This system is designed for disabled people who usually depend on others in their daily life especially in getting from one place to another.
- This system will assist the handicapped people to make them self-dependent for the purpose of movement for which these people are dependent on other most of the times. A person with disabled legs and arms can use this wheel chair efficiently if he is able to move his neck.
- The android app mechanism would bring more convenience for the disabled people over joystick control. The technology can also enhance safety for users who use ordinary joystick-controlled powered wheelchairs, by preventing collisions with walls, fixed objects, furniture and other people. Also, temperature and heartbeat is constantly measured and during emergencies message is sent to the family members

8.2 Future scope

1. The limitation of this system is that people who suffer from the disease torticollis (wry neck) and who cannot move their neck due to some other reason cannot make use of it.

2. Instead of using tilt sensor, optical sensor can be used to detect eye retina to move wheel chair accordingly.

3. Voice command IC's can be used to interface with microcontroller.

4. Another limitation of this system is that it works only when the battey is charged and to overcome this we can find a way to automatically charge the battery with the help of movement of the wheelchair.

5. Further advancements in this wheelchair are possible by decreasing the power requirements of the wheelchair.

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